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INTERNATIONAL QUALIFICATIONS

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INTERNATIONAL A-LEVEL MATHEMATICS

(9660/MA04) Unit S2 Statistics

Friday 17 January 2025 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the OxfordAQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphical calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer all questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.



For Examiner's Use		
Question	Mark	
1		
2		
3		
4		
5		
6		
7		
8		
TOTAL		



		Answer all questions in the spaces provided.	Do r outs
1	(a)	Explain what is meant by a critical region for a hypothesis test. [1 mark]	
			-
1	(b) (i)	The random variable X is known to have a binomial distribution such that	-
		$X \sim B(50, p)$	
		A hypothesis test is carried out at the 10% level of significance with the following hypotheses.	
		$H_0: p = 0.2$	
		$H_1: p \neq 0.2$	
		Find the critical region for the test.	
		Use probabilities to justify your answer. [4 marks]	
			-
			-
			-
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		Annuar	-



1 (b) (ii)	The value obtained for the test statistic is 17	
	State with a reason the conclusion of the test.	[1 mark]
	Conclusion	[i mark]
	Reason	
1 (c) (i)	State the conditions under which a Poisson distribution would be a suitable approximation for a binomial distribution.	
		[1 mark]
1 (c) (ii)	The random variable Y has a binomial distribution and $Y \sim B(80, 0.05)$	
	Show that a suitable Poisson approximation to Y is $V \sim Po(4)$	
		[1 mark]
	Question 1 continues on the next page	

1	(d) (i)	The random variable $~W$ is known to have a Poisson distribution with mean $~\lambda$	outside the
		A hypothesis test is carried out at the 5% level of significance with the following hypotheses.	
		$H_0: \lambda = 4$	
		$H_1: \lambda < 4$	
		Find the critical region for the test.	
		Use probabilities to justify your answer. [2 marks]	
		Answer	
1	(d) (ii)	The value obtained for the test statistic is 1	
		State with a reason the conclusion of the test. [1 mark]	
		Conclusion	
		Reason	
			11











2	(b) (ii)	Hence find the exact value of $E(4-5T)$		Do not write outside the box
			[2 marks]	
		Answer		
2	(c) (i)	Use your answer to part (b)(i) to show that $Var(T) = 0.738$ correct to thr	ee	
		significant figures.	[5 marks]	
		Question 2 continues on the next page		



2	(c) (ii)	Find the value of $Var(4-5T)$	
		Give your answer to three significant figures	
		[2	marks]
		Answer	







Based on his records, Nok's time for one lap of the race track X is normally distributed with a mean of 205 seconds and a standard deviation of 30 seconds.

Following a change in the type of tyres he uses for his bike, Nok claims his mean time for one lap of the race track has increased.

Nok records 10 randomly selected times for one lap of the race track and summarises his total time, in seconds, below.

$$\sum x = 2205$$

Nok assumes that the standard deviation is unchanged.

Test Nok's claim at the 5% level of significance.

[7 marks]



Do not write outside the box

7

4	(a)	For a Poisson distribution $X \sim Po(\lambda)$ where $\lambda > 0$ it is given that	
		$P(X=8) = \frac{125}{2688} \times P(X=5)$	
		Find the value of λ [3 marks]	
		Answer	
4	(b)	The number of advertisements which appear on an app in a 30-minute period is modelled as a Poisson distribution with a mean of 10	
4	(b) (i)	Find the probability of less than 5 advertisements appearing in a 30-minute period of using the app.	
		Give your answer to three significant figures. [2 marks]	
		Answer	



4			Do not w
-7	(b) (ii)	Find the probability of more than 7 and less than 13 advertisements appearing in a 15-minute period of using the app.	outside box
		Give your answer to three significant figures. [3 marks]	
		Answer	
4	(c)	An advertisement appears at 10.15 am on the app.	
		Use an exponential distribution to find the probability that no more advertisements appear until after 10.20 am.	
		Give your answer to three significant figures	
		[3 marks]	1



5 (a) A farmer grows pumpkins to be sold at a market.

The mass in kilograms of each of the pumpkins sold is modelled by

$$X_p \sim \mathsf{N}(\mu, \sigma^2)$$

where μ and σ^2 are unknown constants.

Large pumpkins are defined as having a mass greater than 3.8 kg and account for 20% of the pumpkins sold.

Small pumpkins are defined as having a mass less than 1.9 kg and account for 10% of the pumpkins sold.

Find the value of μ and the value of σ

Give your values to three significant figures.

[6 marks]

 1	4	

 $\mu =$

 $\sigma =$

5	(b)	The farmer also grows cabbages to be sold at a market.
		The mass in kilograms of each of the cabbages sold is modelled by
		$X_c \sim N(0.80, 0.25^2)$
		A sample of size <i>n</i> is taken from the cabbages such that $P(\overline{X}_c < 0.82) > 0.74$
		Find the smallest possible value of n
		[4 marks]
		Answer



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6	(a) (ii)	It is also given that $f(8) = 0.125$	Do not write outside the box
		Find $f(x)$ [5 marks]	
		$\mathbf{f}(x) = \begin{cases} \cdots \cdots$	
		Question 6 continues on the next page	









7		The Zingy Sauce company supply packets of sauce to a fast food restaurant	Do no outsi	not write side the
		The mass of the nackets of sauce are normally distributed		201
		The mass of the packets of sauce are normally distributed.		
		The fast food restaurant takes a random sample of 8 packets of sauce.		
		For this sample, the mass in grams of the packets of sauce were recorded as		
		8.99 8.96 8.99 9.02 8.95 8.98 8.97 9.01		
7	(a) (i)	Calculate the exact value of the sample mean.	[1 mark]	
		Answer		
7	(a) (ii)	Calculate the unbiased estimate for the variance		
•	(u) (ii)		[2 marks]	
		Answer		



The Zingy Sauce company advertise that the packets of sauce have a ma	ss of 9 grams.
The fast food restaurant claims that the mean mass of the packets of saud less than advertised.	ce is
Use the sample to test the fast food restaurant's claim using the 5% leve of significance.	I
	[7 marks]



8	The continuous random variable X has an exponential distribution with parameter λ
8 (a)	It is given that $P(X < m) = 0.5$
	Show that $m < E(X)$ [3 marks]



8 (b)	It is given that $P(X < s) = 0.25$ and $P(X > u) = 0.25$		Do not write outside the box
	Find $u-s$		
	Give your answer in the form $\frac{\ln k}{\lambda}$ where k is an integer.		
		[3 marks]	
	Answer		6
	END OF QUESTIONS		







Question number	Additional page, if required. Write the question numbers in the left-hand margin.



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